

PATHWAYS

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No. 1

A TRIANGULAR TALE

A triangle called Isosceles,
And his friend who was known as Obtuse,
Were arguing over the very best way
To cook a Christmas goose.

"Let's bake it," the Obtuse one said,
"In an open fireplace,
Equilaterally sprinkled
With sage, rosemary, and mace!"

"What nonsense!" said Isosceles.
"I wish you were more Acute!
If we do it the way that you suggest,
It will soon be covered with soot!"

"Then boil it," said the Obtuse one,
"In water that's bubbly hot,
Right on top of the kitchen stove
In a lovely Triangular pot!"

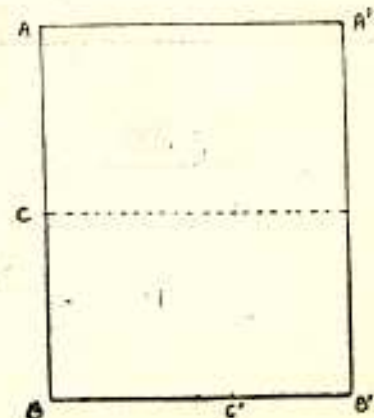
"Gracious, Obtuse, but you are dull,"
Isosceles said with a sneer.
"Why, the only way to cook a goose
Is to roast it, do you hear?"

And while they argued to make their points,
And each angled to get his way,
A Scalene thief with one short leg
Came and stole the goose away!

Author unknown
(Reproduced from the Childcraft Series)

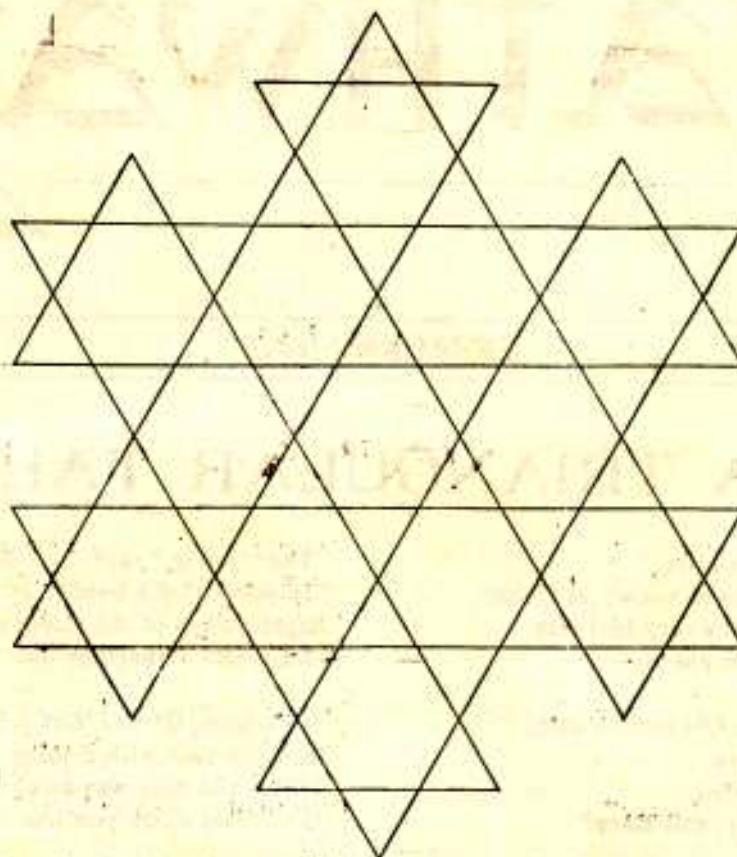
Folding Triangles

Take a rectangle of paper and fold it in half along the dotted line. Bend C downwards so that it falls on the base BB'—that is C touches C'. Crease the second fold. Open out the paper and cut out the large triangle seen. What kind of triangle is it? Cut it in half along the centre fold and obtain two smaller triangles similar to the large one. Combine them to form a parallelogram and then a square. Cut each small triangle into half, into quarters. Explore the designs you can make with them.



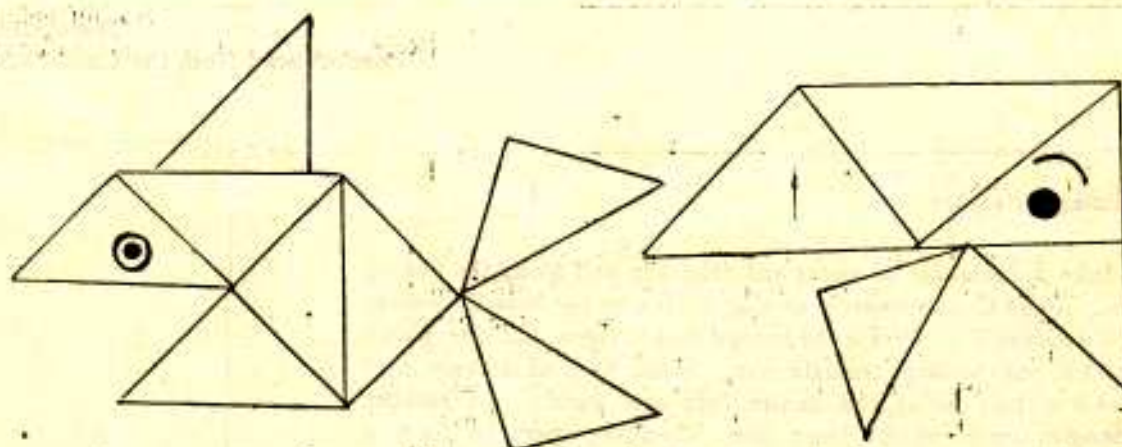
Counting Triangles

The design given here is made entirely of triangles. How many do you think there are? Count up all the various sizes of triangles and see if you can find 88. (Answers on page 16, but don't look just yet.)



Triangle Pictures

Make a variety of pictures by putting together triangles of different shapes and sizes, cut out of coloured paper. Here are some samples. Create more of your own.



THE DYNAMICS OF CLASSROOM INTERACTION

by Jose Paul

Every human being is constantly interacting with other individuals and groups of people. Each of these interactions creates various reactions and these reactions are exhibited in the form of a behaviour. These behaviours may be constructive and positive, destructive and negative or sometimes even neutral. If we can understand what brings out a particular behaviour in an individual or group of people we can modify our own behaviour constructively so as to develop better relationships. This factor is of paramount importance to teachers as they are constantly interacting with children. Hence let us look into the dynamics of human interactions.

What we see and observe in others is only their behaviour. The behaviour of an individual is only the tip of the iceberg. Every human being is an iceberg. Nine-tenths of the iceberg is under water. We see only the one-tenth of the iceberg which is above the surface. If we think that the part we see is the whole iceberg, we are mistaken. It is nine times deeper and even bigger than what we perceive it to be. Hence when we see the tip, we have to visualise the whole which is often obscured to our senses.

When we see a person behaving in a particular manner, in a particular situation, at a particular time, we tend to react to that behaviour. But if we are aware that it is only the outward manifestation of the deeper energy in the person and if we are able to understand the source of the energy that motivates the person to respond in that particular manner to a given situation, we will be in a better position to deal with that person.

What are these motivating factors that bring out a particular type of behaviour? Underlying that behaviour are the thoughts and feelings of that person, the responses of that person to various stimuli, his or her mood at that time, the

general opinion he or she has formed from previous experiences, the influence of peers, personal attitudes, beliefs and values and perhaps many other factors.

The word "thoughts" implies what that person thinks of a given type of situation and or stimuli. For example, if he thinks that you are not trustworthy, he is not going to believe even your true statements. If he thinks that you are not a just person, he will look for some trick even in a just act of yours. Thoughts give colour to stimuli.

A particular stimulus can arouse different feelings in different people. The announcement of the results of a competition can bring different feelings for different students. Likewise, the announcement of an impending test to a class of students can bring about different feelings in different students.

The mood of a person at a particular time can provide a lot of energy to behaviour manifestation. When a parent is upset due to problems in his office his mood is likely to be less than receptive. If his child comes in just then with a prize received at school for some achievements, the parent may just say "O.K. Good". If the parent is in a good mood, he would most likely give the child a warm hug and a kiss.

The influence of past experiences provides tremendous energy to feelings, thoughts and behaviour. If a teacher has caught a particular child cheating in tests one or twice, it conditions his behaviour towards the child. Even when the child has taken the trouble to study, writes an examination honestly and does well, the teacher will react as if the child has somehow copied the answers. The general opinion a person has formed from his own past experiences of others and the influence of peers form yet another powerful source of energy for manifested behaviour.

The attitudes, values and beliefs a child acquires from his family, his cultural background and the society around him are powerful motivating factors. When a child comes to class he is not coming alone: he brings with him his family values, cultural values, religious values and so on. These are some of the most powerful motivations for behaviour. These include positive and negative values depending upon the culture of the family and the community he lives in.

Hence the behaviour that we, as teachers, observe in another person or in a child is not merely the result of the stimuli we provide but the result of innumerable unseen forces that work within the person or child. So when you show appreciation to a child, you provide a stimulus, which results in the child smiling at you. The behaviour of 'smiling' is the result of all the unseen forces that are working within the child. His feelings, his thoughts, his opinion about the appreciation expressed, about you, his values and his beliefs are reflected in that smile. So too, when a child answers back, disobeys or misbehaves with you, it is not merely because of the stimulus you provided. The stimulus is only an opportunity to express his behaviour. His behaviour is the reflection of all the unseen and unobserved sources of energy within him.

Let us take the example of the iceberg once more. We come into contact with others (students) with all our own unseen energy. We exhibit only the tip of our own iceberg, that is, our behaviour. In the interaction between a teacher and a child each one is like an iceberg,

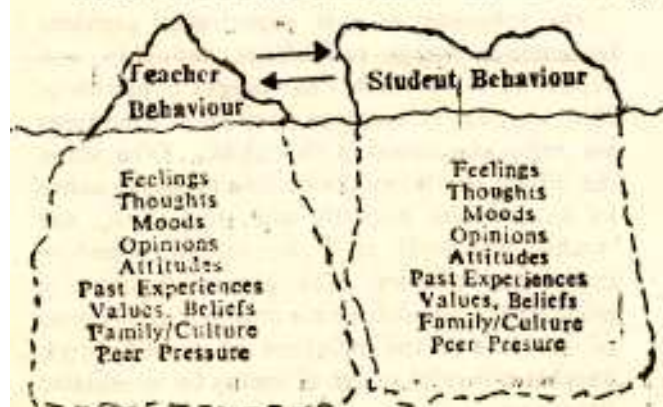
leaving only a tenth part of one's true self visible to the other.

We have to realise first and foremost what our own feelings are, what our thoughts, opinions, attitudes, values and beliefs are, to in order to accept another person. Remember that the child sees only the tip of your own iceberg. He is not capable of looking into the hidden depths of your personality. The child responds or reacts to your behaviour. He reflects his personality through that behaviour. If a teacher wants to modify this behaviour, the teacher has to first see the child as a whole person and not respond only to his/her fragmentary behaviour.

Let me try to clarify this with an example. Suppose a child becomes obstinate or answers back frequently in class. The teacher has got to be dispassionate about the situation. It is not an easy task. The teacher instinctively considers such behaviour as an attack against his authority. It may or may not be actually so. Instead of taking retaliatory action, if only the teacher could listen dispassionately to the child, and try to understand the unseen forces acting within him, he might be able to help him alter these forces. Merely objecting to the behaviour or trying to change it will not clarify either the behaviour or the reasons for it. If we attack only the behaviour, it will be like cutting off the top of the iceberg. The iceberg will automatically come up again in the water.

If a child is obstinate in not doing a particular task which you have assigned, it may not be that he does not want to do it. It may be because of other factors. Perhaps your reactions were negative or neutral to the last assignment that he did for you. Maybe due to other subjects which fascinate him he is less interested in this one. His mood may be upset because of tensions in the family which you are not aware of. More effective teaching methods may be required. Maybe he does not feel confident about completing that task, or peer pressure could be the reason for his defying you. The teacher may not be aware of any of these inner reasons that motivate him to become obstinate.

When he is demonstrating obstinacy, he may not be really angry with you. He is expressing anger about everything that is within him. He is angry. That is important. You don't have to



be angry because he is angry. He is showing his ugly face. Accept that he is angry. Empathise with his feelings of anger. Then work on the causes of the anger rather than on the anger itself. May I repeat that it is not easy, but can lead to a worthwhile solution. Once the anger is expressed, the destructive energy gets out of his system, new and constructive energy can replace it.

So far we were discussing individual one-to-one interactions. However a teacher is generally interacting with a large group of children most of the time. It is as if the teacher is one iceberg floating in a sea full of other icebergs—the children.

Apart from the teacher, each child presents individual behaviour patterns enriched and influenced by the inner personality. Collectively too, the group has feelings, opinions, thoughts, moods, attitudes, values and beliefs and especially peer pressures within it.

When people are in groups, two things can happen. If the common goals and methods of achieving them are accepted and internalised by every member of the group, the group usually functions smoothly. It is not enough that the group is merely aware of the goals and methods. Internalisation of these by every member is important. If the goals of the group are not well defined or not internalised, usually confusion takes place. As a result, rationality takes a back seat and a mob mentality takes over. This is what may happen in the classroom. Even though every student is aware of the goals, usually these goals are not internalised. Hence rational thinking is lost and a group mentality takes over. As a result, the class members may develop unity with regard to unhealthy goals; destructive behaviour emerges.

Before such behaviours start emerging, the teacher needs to be aware of the collective feelings, opinions, thoughts, moods, peer pressure attitudes, values and beliefs of the group. The teacher has to tackle them at that level itself

rather than wait for the resultant behaviour. If teachers attack the undesirable group behaviour with similar behaviour, the classroom may subsequently turn into a battlefield with much subversive activity. It will be good if the collective anger is verbalised by the students and teachers accept feelings expressed from the students' point of view. This verbalisation of the feelings and their acceptance may itself reduce the disruptive behaviour considerably. Patience and listening is the key to this process. This does not mean that teachers must necessarily give in to all the demands of their students. Once, when a whole class became disruptive, a teacher asked them to state all that they felt about the situation and he put it on the blackboard. Then he helped them to analyse their feelings in comparison to the reality of the situation and was able to help them to be rational.

Another teacher in such a situation, asked all the children to write out their thoughts and feelings about the situation. She collated all their writing into one whole and presented it back to the class, thus helping them understand that the teacher and the management had understood their problems. While this did not mean accepting the students' demands, it amounted to accepting their feelings. Of course, if there is a reasonable cause for agitated feelings which can be removed, this course must be sincerely considered.

As teachers we cannot allow things to go on as if nothing is happening; not can we retaliate; these can only lead to more disruptive activity. Likewise every small thing need not be blown up out of proportion. It is sometimes better to ignore minor misbehaviours as they are only momentary and will blow over in no time.

In the case of a class group, it is the teachers' responsibility to help students to internalise their group goals and seek constructive methods to achieve them. This, rather than attacking the tip of the iceberg, the behaviours, will lead to successful resolution of classroom problems.

WHAT IS DISCIPLINE ?

"What is this sir! Is it a class?..." Jaya's father was surprised and a little angry about the class under the tamarind tree. He warned the children, "Children! Sit straight and listen the lesson attentively..." and went away to his fields. I just smiled at him, turned towards the children and asked them,

"So, you say Shankranthi is farmer's festival, o. k., how?"

"It is because..."

—Jaya pulled my legs

—Narayana got up and ran towards me and pulled my shoulders

—Vijaya raised her hands and shouted, bent on answering first

—Mallikarjuna stood up and bent on to the children to give the answer with eagerness

—Malli started requesting me to give the first chance to her

—Sudhir—just sat before his writing table with a smile.

Every child is anxious to give a reply. Because of this anxiety and eagerness, it does not look like a class—every time this conversation process creates a big noise—a noise like in a village fair! Though the children may try mischief, they will all be involved in the conversation. Children like Sudhir who has not much intimacy with others, also cannot sit quietly. I cannot allow my children to sit quietly! I like to involve everyone by asking their opinions. For this I have to tolerate the rudeness of the children—one pulls my shoulder, another pulls my legs, someone scratches my knees—these are rural children, poorly civilised children!

Every child knows the answer, based on their own family background and their surroundings,

each one has their own answer!! Every one has his own rich experience!! But, they get confused when they put their experiences into words!! And moreover there is an eagerness to say something! They do not want to express themselves by a realistic and logical answer, but, are eager to say whatever strikes to them...

That was the base for my method of teaching... I am like a brother to the children, not a teacher—to read the lesson, explain the meanings, opposite words, and ask them to memorise questions and answers! First I gather what the children know, then I put them in an order, and from these known things I will lead the journey towards the "unknown", both logically and philosophically. I feel it is the right way of education!

When I start the class under the tamarind tree or in a classroom I throw lots of doubts to them. Then the noise starts. Certainly they quarrel, but they slip into the process of thinking! Everybody wishes to contribute something! Malli thinks very slowly, and she responds later. We can not pressure her to contribute immediately! Sometimes even after the school finishes, she will come back to the school in the evening and give the answer. Sometimes they will start the next day with their observations.

This method is really a disturbance to the other classes. Onlookers may feel bad with the noise! They may get angry with this undisciplined class—like Jaya's father! But what to do? I feel that this is the way in which they are really learning to think, getting a real "education".

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DO YOU KNOW....?

1. February 28 is National Science Day

Some suggestions for activities culled from the NCSTC News (Volume 3, No. 8 of November 1992).

- NCSTC has developed a kit and trained over 1000 people to explain the *Science Behind Miracles*. Have you seen a demonstration?
- Set up a *Know-How Corner* to provide information on specific daily-life situations like food adulteration and water contamination, conservation of energy, fuel and materials. The NCSTC has developed a kit for testing water for contamination and food for adulterants.
- Scripts in the form of plays/songs and riddles based on school science and related issues are available with NCSTC.

Have a competition and ask students to write scripts of their own.

- Some exhibition idea booklets/panels are available with NCSTC. Topics include Weather and We, Population and Development, Aerodynamics in India.

A training workshop on the principles of aerodynamics can also be arranged through NCSTC.

- NCSTC hopes to publish soon a booklet/computer programme on quiz competitions.
- Seek their help in arranging a workshop to train students in Origami—the art of paper folding.
- NCSTC has a portable planetarium and slide shows for school programmes on Sky-watching and Astronomy. A booklet on simple low-cost astronomy experiments is under preparation.
- Books on toy-making using low-cost materials and waste have been prepared by NCSTC. (We have brought these to your notice in earlier editions of PATHWAYS.)

Contact Dr. Madhu Phull, National Council for Science and Technology Communication, Dept. of Science and Technology, Technology Bhawan, New Delhi-110 016—Telephone: 662260 (PABX).

2. FORTELL is a forum for teachers of English Language and Literature in India

Started in September 1989, it aims to promote the professional development of these teachers, to collect and disseminate information useful to them. The group has held seminars and workshops and brought out a Newsletter. They would welcome your involvement.

Annual membership fee is Rs. 50/-, Life membership fee Rs. 250/- payable by Cheque/Demand Draft. Outstation members must add Rs. 10/- extra as bank charges. Fees may be paid to Mrs. K. Ojha, Coordinator, Dept. of English, School of Correspondence Courses, Delhi University, Delhi 110 007. Write to her for more details.

3. Book Review: Science Teasers

Edited by Dillip M. Salvi and
published by Konark Publishers Pvt. Ltd.
Delhi 110 092 (1989)

Science Teasers is a well-prepared book that serves the purpose of motivating young students to build up informally their knowledge about interesting things related to science and technology. It also helps them test their knowledge and thereby gain confidence. It provides 108 well-designed teasers covering a large panorama of topics related to science and technology of interest to the students of age group 8-18. The book would interest even the parents having new interest in science and technology. This book is rather costly. But looking at its rich contents, printing, illustrations, and durable binding it can be afforded by school libraries.

There is yet another similar title by the same author, *More Science Teasers*, by the same publishers.

A MUSICAL BOX OF TRICKS

The teachers of today are making an increasing use of the portable cassette tape recorder as a teaching aid in their classrooms. It provides variety in the voices that the children listen to, focusses their attention on the lesson and improves concentration. Language teachers, both in Hindi and English, can make tapes of their own story—scripts, using colleagues and friends as the characters. The following suggestions might be helpful in creating sound effects.

• Use Cellophane or Foil

Crumple up cellophane or foil to simulate a marching battalion or the departure of a train. Balloons can create rubbing and whistling sounds. Filled with little balls (dried peas or lentils), they can give you the sound of the sea.

• Trotting Horses

Use two halves of a coconut shell... put them down on different surfaces in varying rhythms—try sand, pebbles, felt, water... for the different terrain.

• Fire

Crumple cellophane or foil slowly to sound like an open fire. Working faster and breaking matchsticks as well, it sounds like a forest fire.

• Creepy Footsteps

Leather soles on a creaking floor board. Play back the recorded sounds at half speed and add some echo to make it sound like hollow creeping footsteps.

• A Squeaking Door

Unscrew the hook of a wooden coat hanger. Screw in a wooden peg. Turning the wooden peg inside the wood makes a horrible sound!

• Wind

Blow gently across the microphone. Use the balloon again to create a storm. Create a hurricane by swinging a stone tied securely to the end of a string.

• A Lift (Elevator)

Use a vacuum cleaner or an electric coffee mill. Imitate the sound of doors opening or closing by rolling a toy car or a castor across a table.

• Screams

Record the crying of a baby and play it back at half speed—add a little echo.

• A Harbour

Create waves by moving your hand in a bowl or bathtub of water. Ships' horns come from blowing on bottles filled with varying amounts of water.

• Rain

Pour rice from a bag on to an empty cardboard box. Or sprinkle sugar on a sheet of drawing paper or cellophane.

Rice falling on to thin metal foil sounds like hail.

• Thunder

Thin metal foil or a sheet of thick cardboard held at one corner and shaken a bit, 'thunders' beautifully... add echo.

• Factory

Use a hammer and knock on glass, stone, wood. Switch on the coffee mill/vacuum cleaner... mix it all on the tape.

Have fun making your taped script come alive!

THE IMPORTANCE OF SCIENCE EDUCATION IN THE PRIMARY SCHOOL

by

Ms. Gayatri Moorthy

The broad goals of science education may be summed up in four key words: **ATTITUDES, PROCESSES, KNOWLEDGE and SKILLS.** Science Education aims to:

- develop in students, attitudes of curiosity, of wonderment about and involvement with phenomena in their natural environment; to develop their appreciation for the contributions of science to daily living; to develop in them inclinations towards solving problems in a scientific manner.
- develop in students those intellectual processes of inquiry by which scientific problems and phenomena are explained, predicted and/or controlled.
- develop knowledge of the facts, terminology, concepts, generalizations and principles which help students confront and interpret their environment.
- develop in students the skills and ability to handle, construct and manipulate materials and equipment in a safe manner; to measure, organise and communicate scientific information.

To teach science is not to teach bits of biology or physics or chemistry. Children in our primary schools learn about plants and animals, atoms and molecules, energy, machines and a variety of other things. None of these facts and formulae adds up to science. All of them speak about science. They are important and have to be mastered at some point of time in our studies and yet are not science. They are only vehicles for understanding what science is all about. Too often our syllabi and textbooks, and therefore, teachers, equate these facts and this terminology with genuine scientific understanding. No doubt, this is what led a teacher of English to remark to me once, "Science does not teach

thinking! It is only a collection of facts which our children memorise and repeat at examinations".

Science teachers would throw their arms up in horror at such a remark, but they would do well to closely and honestly examine exactly what it is that is being carried out in so many classrooms in the name of teaching science. With the ever-present threat of an examination at the end of each year, our main problem seems to be one of "covering the course" and making our students (particularly those in primary classes) word-perfect so that they score well.

Children live in a world of science and during their entire lives will encounter scientific matters. They will use a variety of "scientific" devices, work at jobs that are linked, directly or indirectly, with science. As adults, they may be called upon to make decisions involving science—on conservation, on pollution, on population, control—and some may get involved in scientific research or exploration. Thus it becomes imperative that the citizens of tomorrow be made *scientifically literate*. They need to become acquainted with the bare facts of science and the processes of science.

Fortunately, science is naturally appealing to children. It can become their favourite study—depending on how it is presented to them. It is an excellent medium for teaching much more than mere facts. It helps pupils to organize their ideas, and think logically. It can serve as a means of teaching, reading, writing and mathematics. It is ideally suited for developing qualities like honesty, cooperation and respect for the opinion of others. Good science teaching leads to what is often called a 'scientific attitude'—curiosity about one's environment, formulating questions and seeking answers,

being honest, objective and analytical, being wary of hasty judgements, being able to weigh evidence carefully and reaching conclusions with caution.

Far more important than facts, such attitudes must be developed in our pupils. They probably can, if we use the proper approach. But we must not take it for granted that they appear automatically with the mere acquisition of information!

There is an explosion of knowledge in the world today which makes it imperative that we develop in students skills which help them to learn on their own, rather than feed them with information. 'Learning to learn' is thus far more important than learning facts. If we accept this as a basis for our teaching, it implies that there must be a tremendous change in *our own attitudes*. But first, we must find out what constitutes a good science lesson. What skills are we trying to develop in the children?

The most fundamental skill is *the ability to ask precise questions*. It arises out of the natural curiosity of the child. Children often ask inconvenient questions; ones to which adults cannot supply a ready answer. If this questioning is frowned upon and obstructed, over the span of a few years the pupils lapse into a state of passive acceptance, indifference, and sometimes, disinterest. An attitude of "Let's find out..." on the part of the teacher would prevent this happening.

How should children *find out*? Information can be collected from many sources — from people, from books, newspapers, magazines and other reference materials. Learning how to conduct an interview or obtain information from books like dictionaries, maps, directories and encyclopaediae are important skills, relevant to life in a modern world.

Another way of obtaining information is by *carrying out a simple experiment*. The environment abounds in situations in which children can observe, enquire and enjoy a 'hands-on' type of experience. The clever teacher takes advantage of these, realising that an experiment

does not necessarily need a laboratory or elaborate equipment.

Asha wanted to know how quickly a potato plant grew. Her teacher encouraged her to find out from the school *mali* how potatoes were grown, what type of soil and weather conditions they needed. With his help, Asha obtained a pot of soil, some potatoes and set up her experiment on the window sill of her classroom. Her teacher helped her to maintain a daily record. In words and pictures Asha described the growth of the plant and at regular intervals she took measurements of its height.

Much can be learnt through careful, patient *observation*. Anil and his friends, out on a nature walk in a park, found a strange looking red and black beetle. They caught a few specimens and (with permission) took back samples of the flowers they found it eating. In school they were helped by the librarian to find the name of this beetle. Keeping it alive in a large glass bottle involved them in a search for the flowers and other food it preferred to eat. Looking at it closely they learnt to identify the parts of its body. This, in turn, led them to recognition of the bodies of various insects found in their school garden.

The real essence of science is *honest enquiry*. Scientists discover new things because they enquire constantly into the unknown. The things that children find out through improvised experiments of the type described above may not be new or startling to the teacher, but *every small discovery is exciting to the children*. Traditionally science teachers have arranged *demonstrations* or 'experiments' that are not experiments at all! They are merely verification of facts already known to both pupils and teacher. While these certainly have value, there is no joy greater than finding out on one's own. Such genuine experiments develop in pupils self-confidence, a willingness to try new procedures and an open-mindedness that make them test out each idea for its validity before accepting it. Thus the most effective experiments are often those which arise from the pupil's own questions.

The data collected during experiments must be *systematically recorded*. Records may be made in many ways. The most common form is a written description. This may be enhanced by the addition of coloured sketches, drawn from a child's point of view. While they might lack the precision expected of students in higher classes, they would help the child communicate important findings more effectively. Measurements and repeated observations may be put down in tabular form. The compiled data may be converted into a pictograph or a bar graph. Clay or plasticine models might help a child to explain the construction of equipment. Photographs, a valuable modern aid, might also be considered as an excellent form of recording information.

In *collecting and recording data*, children learn their first lesson about scientific methods of enquiry. *Discoveries in science are most often the result of repeated trials laboriously recorded and painstakingly analysed*. Repeated attempts to carry out an experiment, however simple, produce results of greater validity, make children more aware of subtle details and relationships, give them more opportunities to question and suggest new ideas and provide them with the satisfaction of doing it 'just right' more than once.

Once records are made, they should be used. For example, when Savitri and her friend, Anjum, improvised a rain gauge, they used it to measure the daily rainfall over a period of one month. They could then make a bar graph of their results, and at a glance find answers to questions like:

On which day did it rain the most? the least?

On which days was there no rainfall?

What was the total rainfall for the month?

If they have done the corresponding mathematics, they could calculate the average daily rainfall in previous years, further comparisons might become possible. *Comparing and contrasting* characteristics is a skill which all scientists need in order to obtain useful results from the information they collect. A collection of leaves might be studied closely in order to

classify them. At primary level, this classification may perhaps be done in a non-technical way, using terms which come easily to the children, but it will lead them to observing each specimen closely. As the classification exercise proceeds, each leaf will be placed in a separate category of its own and described using words like these: long, wide, pointed tip, thick, rough on top side, curly edges. The leaves themselves may be dried, pressed and pasted into notebooks or crayon rubbings may take their place. The branching classification diagram will provide a record which will help students *recognise* these characteristics in other leaves that they may find later. While on their collecting expedition, the teacher would have warned the students not to pick up more than one specimen of each kind—a necessary step to prevent destruction of all the trees. Discussion with the pupils would help them understand how each one of them has a role to play in the preservation of their environment. This would lay the foundation for sound adult attitudes towards the world the children will live in as adults. It is worth noting that environment-based experiments lead to *multi-disciplinary learning* in many fields. Working *through* the environment the teacher inculcates in the students skills they need to acquire. They learn facts *about* the environment and at the same time opportunities arise to influence and mould their attitudes *towards* their environment.

Experiments may be improvised from the kind of facts which we traditionally teach primary school children. To learn about conditions which help evaporation children could set up experiments on the drying of cloth. Samples of different materials, all of the same size, may be dried under identical conditions to find out which kind of cloth dries fastest. To find out if clothes dry better in sunlight or shade, the children would use two identical samples of cloth (same material, same size) and dry one in the sun, the other in the shade. Such experiments would give them valuable training in the *scientific principle of changing only one variable at a time in an experiment* of this kind.

As children carry out their experiments there are bound to be some that do not succeed. *Failures can teach as much as successes*. Valu-

able lessons stem from finding an answer to "Why did that happen? Why didn't it work?" Likewise when the experiment works out correctly, finding the reason may lead the students towards seeking and identifying a *cause and effect relationship*.

Children may draw *simple inferences* based on past experiences. Oil is 'thick' and hence must be heavier than the 'thinner' water. Can they design an experiment to test out this hypothesis? Two identical medicine bottles, a common balance (even a toy one will do) and a collection of weights will supply the answer. The children should recognise the need to weigh the empty bottles, before re-weighing them filled with oil and water respectively. If their findings do not support their *prediction* they could try to find reasons for their result. While the concept of density might not come till the students reach the middle school, some of them might remember the fact that oil floats on water. This might lead them to saying that "Oil is lighter than water". Readers might question the need for this kind of learning — to try experiments which do not lead children to the absolutely final and correct answer. I would point out here, that firsthand experiences are the basis of most learning. As we grow, our understanding of all concepts deepens and expands. As young children we may not fully grasp that multiplication is repeated addition. Later in life, when we have to add the same number six times over, we merely end up multiplying it by six.

I have often tried out the above experiment with adults, including senior teachers of science. Almost always their prediction has been that the bottle of oil will be heavier. One such teacher, when the analogy to the density bottle experiment was pointed out, exclaimed, "Good Lord! I teach this every year to my students—but only the conventional experiment"—a clear case of science having no meaning except in terms of the text-book and the examination!

The problem of floating and sinking presents us with an interesting case-study of such an improvised experiment. I have tried out the same experiment with primary school teachers at workshops and we have often had interesting

results and discussions. The teachers were given an assortment of common objects—rubber washers, metal screw caps, a drawing pin, a razor blade, a small piece of wood, a larger piece of wood, foil caps from milk bottles and so on. Asked to predict which objects would float and which would sink, teachers tended to base their predictions on one attribute, not necessarily the correct one. For example:

Prediction	Finding
Objects made of metal will sink.	The metal screw cap will float even if it contains some water. The drawing pin will sink. The foil cap will float. The razor blade floats sometimes; at other times it sinks.
Wood will sink—it is heavy.	The small piece floats—it must be light. The large piece, which is heavier, will certainly sink. Surprise — that also floats!

Based on their findings, the teachers spent much time in discussing whether they could:

- make the floating objects sink
- and the sinking objects float.

They found out that the same object (say the aluminium foil cap of a milk bottle) could sink in certain conditions and float in others. They recognised the need to be less dogmatic, to try things out for themselves, to make repeated trials, to question everything they did.

Science deals with the everyday things of life. Hence, those very same things constitute a fantastic learning laboratory and all its equipment. Commonplace, inexpensive items like paper clips, shoeboxes, marbles, candle, bread, string, scraps of wood and paper cost little or nothing, yet they can be used to provide youngsters with valuable learning experiences. The students get involved in assembling their "equipment" and are not put off as they might be with complicated laboratory apparatus. Such material is available in quantity and allows all the students in a

class to work at their own experiments. Being inexpensive, they cause no financial problems when experiments have to be repeated and modified. Pupils can continue learning outside school, parents can become involved, creativity can be stimulated and manual dexterity improved in all children, including the 'slow' learners. My personal experience, although with a middle school class, proved that the so-called 'weak' students enjoyed such improvised experiments enormously and they served to kindle their interest in the subject and improve their learning. All this bears out the old Chinese saying:

I hear and I forget,
I see and I remember,
I do and I understand.

Any school teacher reading the above is bound to say "That's fine as theory. We have no time within the constraints of our syllabi and timetable to put all these ideas into practice in the classroom?"

Obviously, if we accept that the development of skills is of greater importance than the mere learning of facts, we must take concrete steps towards ensuring that this change can take place. It is an encouraging sign that the NCERT itself has recognised the need for this change by publishing several years ago a valuable document called *The Minimum Learning Continuum* (Primary Curriculum Development Cell — Publication No. 3, August 1979). It spells out clearly the *competencies* that children in each year of the primary school should acquire in the fields of language, mathematics, environmental studies, healthy living, SUPW and creative expression. It is interesting to note that the skills listed under the heading of environmental studies are as follows:

- (i) Observing and formulating precise questions relating to the natural and social environment.
- (ii) Recording and reporting systematically.
- (iii) Collecting information from relevant sources and using it in a given situation.
- (iv) Classifying objects, events, phenomena, social and physical data based on given criteria.
- (v) Identifying and understanding cause and effect relationships.

- (vi) Drawing simple inferences on the basis of experience.
- (vii) Designing simple experiments to solve problems.
- (viii) Drawing free-hand maps and locating places in the map indicating directions and distances on the map.
- (ix) Taking care of living things in the environment and showing interest in the environment.
- (x) Avoiding wastage of natural resources.
- (xi) Avoiding pollution of the natural environment and keeping the surroundings clean.
- (xii) Living cooperatively.
- (xiii) Showing respect to various cultures and religions.
- (xiv) Taking care of private and public property.
- (xv) Questioning various practices in society to negate superstition.
- (xvi) Showing respect for the rules and laws of school, society and the government.

The Minimum Learning Continuum spells out clearly the progression of these skills in each year and defines the expected competencies at the end of Class V — a terminal stage for many of our school children.

In the light of this, the most urgent task would be to take a long, hard look at our primary school syllabi. As they stand today, these syllabi are spelt out in terms of the *content* the children are expected to master. They are even divided in terms of teaching periods, specifying how much time is to be spent on *teaching* each topic. We must shift the emphasis to *learning*, where the teacher is a guide, a facilitator who helps the students to learn by organising suitable learning experiences. Obviously there will be no learning without content, but is it not possible to reduce the content to some extent?

The topics to be studied should also be carefully re-evaluated in the light of what a child in modern India is exposed to in his environment. For example, simple facts about electricity — the use of cells, conductors and insulators — are known to most primary school children through their life-experiences. Yet syllabus planners

have felt that these facts should not be taught till class 8, and that too, after the child has learnt the more abstract concepts of static electricity!

The syllabus should also give suggestions on the type of activities a teacher should be expected to carry out. The learning outcomes of these activities, in terms of the skills they seek to develop, must be explained to the teacher. Ideally, these details should be put forth in the form of teachers' guides, but such books find little use in the day-to-day work of a school teacher. Putting these ideas into the syllabus will also ensure that authors of text-books do not cram their products with an unnecessarily large number of needless facts—many of which are far above the understanding level of the primary school child.

Within each school, teachers must be given some degree of freedom to plan and carry out science activities. Close supervision by suitably oriented heads of schools will ensure that such time is not wasted; that children are actually involved in doing and learning. While this may not seem feasible in all the primary schools of our country, a beginning has to be made and for

this a few schools may be selected in each district. Readers are, no doubt, aware of the Hoshangabad Science programme in Madhya Pradesh. Starting in only a few selected districts it has now been dispersed all over the state. It brought together people from diverse backgrounds and experience to re-orient the syllabus, to make it more meaningful and life-related for the pupils, and to train teachers by working along with them.

The changes that this kind of science education would necessitate will mean a re-orientation of our teacher training programmes as well. Student-teachers must now be trained to think specifically in terms of the skills they will seek to develop in their students. Lesson planning must be given a new slant—one which takes it away from covering a set number of pages in the textbook.

All this seems a tall order, and yet it is heartening to see that some institutions and people are thinking on these lines. One hopes that eventually the teaching of science in our primary schools will produce thinking, caring, aware citizens in the years to come.

Use Your Dictionary

Try the following exercises to appreciate the diverse uses of a dictionary.

1. Find the meaning and pronunciation of: ennui, ensemble, coup d'état, bizarre.
2. Can you tell why a safari suit is so named?
3. Find the expansions and meanings of: i.e., viz., sic, e.g.
4. What is the difference in the meaning of 'fair' in the following two contexts?
He was fair in his dealings.
This place has been reserved for the fair.
5. Fill up the blanks with wear, were or where.
.....you able to get this evening?
6. Can you find the origin of the words, catamaran, patchouli, patamar, nulla.
7. Which is correct: co-operation or cooperation, fulfil or fulfill or fulfill?
8. How do you pronounce consult, consultation?
9. Fill with advise or advice.
The father.....his son to opt for engineering.
The son accepted the
10. Find the meanings of: come, comedown, come upon, come down upon.

The Bank—A Project Outline

A study of the functioning of a bank provides opportunities for learning several useful skills. Today, in many schools there are bank counters and it may be possible to arrange a visit after consultations with the local Manager. This will be the high point of the project, but much work can be done with the pupils beforehand. Here are some suggestions:—

1. Start off by discussing how people kept their money and valuables long ago, the system of barter and how banks came into being.
 2. Invite a parent banker to school to talk to the class about the functioning of banks.
 3. Get students to write a formal letter to the Bank Manager, seeking permission for the visit and to interview people at the bank. Seek interviews . . . with specified personnel. Give details about the date and time of the visit, the number of children who will be coming, what they wish to see.
 4. Help children plan intelligent, useful questionnaires for their visit who would they like to talk to apart from the manager—the cashier, someone in charge of savings and fixed deposits, the guard, some selected customers?
 5. Help students understand the concept of interest. Simple numerical work will show them how to calculate the growth in savings when left in a bank deposit.
- When and how can children open accounts at a bank?
 - How are computers used to keep the accounts in a bank?
 - What steps does the bank take to prevent robbery and theft?
 - Does this bank have lockers? How does this system work?
 - What is meant by the Closing of Accounts? When is it done each year?
(A parallel between the monthly stocktaking procedures in a kitchen or a shop could be given)
 - If the bank is in the school premises, collection of school fees and maintenance of records could be talked about.

Subsequent to the visit the class could:—

Some areas on which children may collect information during their visit:—

- What does the bank do with the money its clients leave in their accounts?
- What are the rates of interest on savings accounts and on fixed deposits of various durations?
- How are cheques written?
- write "thank - you" letters
- present careful systematic reports of their visit. This information could be shared with other classes in a written/oral presentation.
- write a story about an attempted bank robbery or improvise a stage presentation of the same.

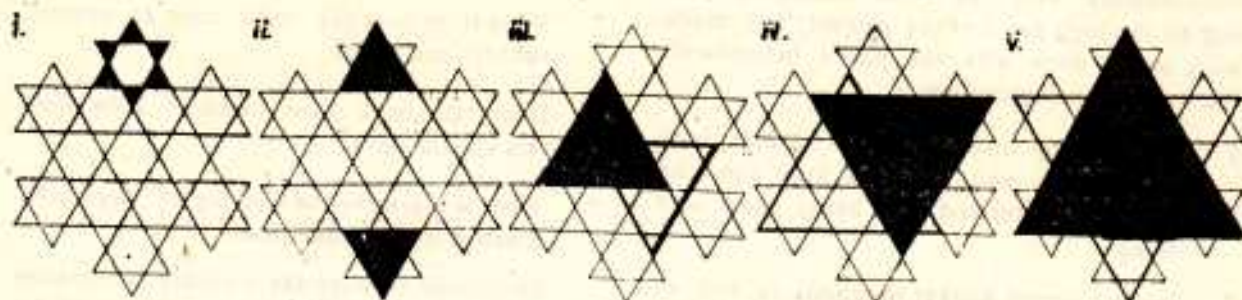
Other possibilities include: The Autobiography of a Coin or a Rs. 5 note, How the Bank Helped a Family in Need, How Mr. X saved enough money to help his children through their education etc.

- open an account at the school counter, where money could be collected for a good cause, or saved towards an annual event like a class picnic etc. Let students calculate in advance what target they wish to achieve

and how they will set about it. Will they need to collect on a weekly basis? Or will they make a single collection and place it in a short term deposit? How much interest will they earn?

The culmination of the project could be in the form of an exhibition of all the children's work on bulletin boards, in files/albums, or in the form of oral presentations—talks, skits and drama.

A TRIANGULAR TALE—ANSWERS



- (i) There are 42 triangles of this size pointing in all directions.
- (ii) There are 26 triangles of this size, 13 point up and 13 point down.
- (iii) There are 12 triangles of this size, 6 each pointing up and down.
- (iv) 3 triangles like this point up, another 3 down—total 6.
- (v) 1 triangle each pointing up and down—total two.

Hence the total number of triangles is $42+26+12+6+2=88$

WAX FLOWERS

Light different coloured candles and let the hot wax drip into a bowl of cold water. When the wax touches the water the drips will form into flower shapes. Now stick the petals on thin flexible wire sticks to make nice colourful flowers.

